Automated Syringe-Loading Device

Project for RERC-AMI

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Outline

• Introduction
• Clients
• Purpose
• Previous Work & Patents
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Introduction

Affects 20 million children and adults in the US alone

What is diabetes?

• Disorder in which the body is unable to properly produce or use insulin

• Insulin: hormone required to convert sugars and starches into energy
Clients

Conditions/Disorders faced by potential users:

- Arthritis
- Amputation
- Hemiplegia (side of the body can become paralyzed)
- Parkinson’s Disease (tremors, decreased range of motion)
- Wheelchair-Bound & Limited Range of Motion
- Neuropathy (numbness, pain)
- Loss of Vision & Hearing
Purpose

To create a device that will:

- Accurately dispense insulin from any size bottle to any standard syringe
- Have limited user interaction
- Alert the user
- Keep time-stamped records
Previous Work Done by Others

- Insulin Pump
- Insul-Cap
- Load-Matic
- Count-a-Dose
- Senior Design 2005
Patents

• #435791: Syringe apparatus for low vision/hearing patients; uses audible sound or tactile stimulus

• #4778454: Syringe loading fixture for low or no vision patients; uses gauge for measurements

• #7025757: Syringe loading device; uses a drive member to impart motion

(http://www.freepatentsonline.com)
Microprocessor

- PIC24
- Controls:
  - LCD
  - Speech Output/Recognition & Keypad
    - 2 Servo Motors
    - 1 Stepper Motor
- Features
- Monitors various sensors used to safely and accurately track the components
Keypad Input

- Custom made with large keys for users with visual impairments
- May be faster/easier than speech recognition
Speech Recognition Input

- Assists users with difficult in motor control & visual disabilities
LCD Screen

- Large graphical display
- Assists visually impaired
- Customizable fonts to appeal to wide range of users
Speech Output

- Prompts user for input
- Assists visually impaired
Insulin Bottle Holder

- Holds two types of insulin bottles
- Spring at top ensure the bottle remains in place when insulin is extracted
- Insertion is similar to battery
- Sensor used to determine presence
- Access granted by door on case
Insulin Bottle Holder Assembly

- Servo is used to move the holder upwards and downwards to meet the needle of the syringe
  - Gear and gear track affixed to servo and holder, respectively

- Track on the backside of the holder is used as a guide for the bottle holder to move along

- Two sensors determine location
Syringe Cartridge

• Machined from aluminum
• Holds maximum of 10 syringes at one time
• Clips used to hold syringe in place
• Grips of syringes fit into grooves
• Two sensors:
  – Presence of syringe
  – Size of syringe present
Syringe Cartridge Assembly

• Servo motor used to rotate cartridge

• Moves in counter-clockwise motion to present at door of case after syringe is filled with insulin
Plunger Claw

• Purpose:
  1) Pushes plunger upwards, prior to filling, to ensure there are no air bubbles
  2) Pulls plunger from syringe to extract insulin

• Made of plastic

• Attached to a lead screw that provides track for upwards and downwards motion

• Designed to meet number of required movements
Plunger Claw Assembly

• Stepper motor is attached to lead screw by gears

• Rotation of gears turn lead screw which in turn moves plunger claw upwards or downwards depending on rotation direction

• When syringe has finished dose, it is turned away from claw and plunger slides out
Frame/Case

- Frame is constructed with aluminum
- Each component is secured to the frame
- Designed around final case
- Doors to access holder, syringe & cartridge and to access components for repair
Automated Syringe Loading Device
## Expenses

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<th>Part Description</th>
<th>Quantity</th>
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**Total Current Cost** $1,600.46
Acknowledgements

• Dr. John Enderle
• David Price
• RERC
• Jennifer Desrosiers
• Lisa Ephraim
• Lee VanHennik
Questions